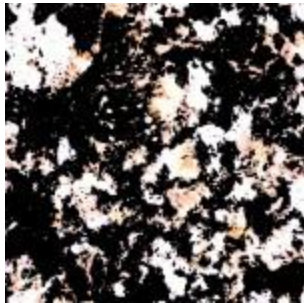




## Fractals and Health



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**By: Rob Zielkowski**

Fractals are geometric patterns that are repeated over scale (in space and/or time) to produce “self-similar” irregular shapes and surfaces that cannot be represented by classical (Euclidean) geometry (such as rectangles, cubes, and pyramids). Although practically absent in our man-made environment, fractals are found everywhere in nature – in trees, leaves, snowflakes, waves, rocks, clouds, as well as in our own bodies (our skin, lungs, brains, circulatory system, heartbeats, even the sloshing of amniotic fluid before we were born). Fractal geometry is at the foundation of all of creation which is natural (not made by humans).

There is a growing body of evidence that viewing particular fractals can produce profoundly beneficial health effects in humans. To understand this, we need to first briefly review the findings of Biophilia and Attention Restoration Theory (A.R.T.)

### *BIOPHILIA*

The word Biophilia, used by psychologist Erich Fromm and popularized by E.O. Wilson, means “love of life or living systems”. Modern day psychologists have acquired empirical evidence in support of the Biophilia Hypothesis, which states that human beings have an innate biological predisposition to react positively to nature. In the words of Roger Ulrich of The University of Texas A&M, “There are well over 60 published scientific studies....which have consistently shown” that people will experience profound psychological and physiological stress relief by merely viewing natural scenery, and that “this effect is fairly generalized across different

systems, from the brain, to the heart, to the sympathetic nervous system, to breathing, to stress hormones, and so on” [1].

### *A.R.T.*

Attention Restoration Theory (A.R.T.) asserts that exposure to nature instantly and unconsciously produces significant improvements in cognitive functioning. Experiments conducted at the University of Michigan by psychologists Stephan and Rachel Kaplan and their colleagues are part of a rapidly growing body of evidence for A.R.T., showing a myriad of ways in which exposure to nature can contribute to brain health [2-7].

At the University of Illinois, Frances Kuo and William Sullivan performed experiments which not only validated A.R.T, but also extended it by demonstrating that *viewing* nature, in addition to improving health and brain function, actually lowered levels of irritability, aggression, and violence [8, 9].

Researchers at the University of Washington, led by Peter Kahn Jr., have discovered that these positive health effects can also be obtained by viewing technological simulations of natural scenery on plasma screens [10, 11]. At Oberlin College, F. Stephan Mayer arrived at similar results in three separate studies, which concluded that watching a video of nature even helped increase a subject’s ability to resolve personal problems [12].

### *THE MODERN ENVIRONMENT*

In our modern world, exposure to nature is being reduced and humans are progressively becoming deprived of its restorative effects. This causes an unhealthy buildup of stress. Prolonged stress mobilization in humans produces a plethora of harmful consequences, such as increased blood pressure, energy depletion, release of stress hormones, decreased cognitive ability, reduced immune function, etc. All of these negative effects are quickly reversed by simply looking at natural scenery, and this reversal has been shown to occur in only minutes, even seconds [13, 14].

What exactly is it about simply viewing natural scenery that produces such fast and powerful health benefits?

### *FRACTALS AND HEALTH*

The answer can be found in the very geometry of nature – in fractals. Researchers at universities around the world have shown that looking at fractal shapes of mid-range complexity generates a sense of well-being and peace in the observer. Measurements of skin conductivity, as well as evaluations of EEG’s and fMRI’s, have led scientists to the conclusion that it is the fractal geometry which underlies the stress reduction and the many positive health benefits of viewing natural scenery [15-20].

Because of their aesthetic appeal, fractals have become popular as computer screen savers, and have been used, usually subconsciously, in some forms of art and architecture. Why this appeal

is apparently universal in humans is the subject of studies done at Harvard Medical School, in which evidence shows that the electrical signal profiles of the human nervous system follow fractal patterns [21, 22]. It seems as if our minds possess the natural inborn propensity to recognize and resonate with fractals. Regardless of the particular reason or mechanism involved, it is becoming clear that, in the words of philosopher Dr. Yannick Joye of The University of Gent, “it is not the tree that causes these [biophilic] emotional responses, but the fractal mathematics of the tree.” Plainly put, looking at fractals is relaxing and good for us [23].

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